

Wavelength Shifter
(With Stabilization and Data Encoding)

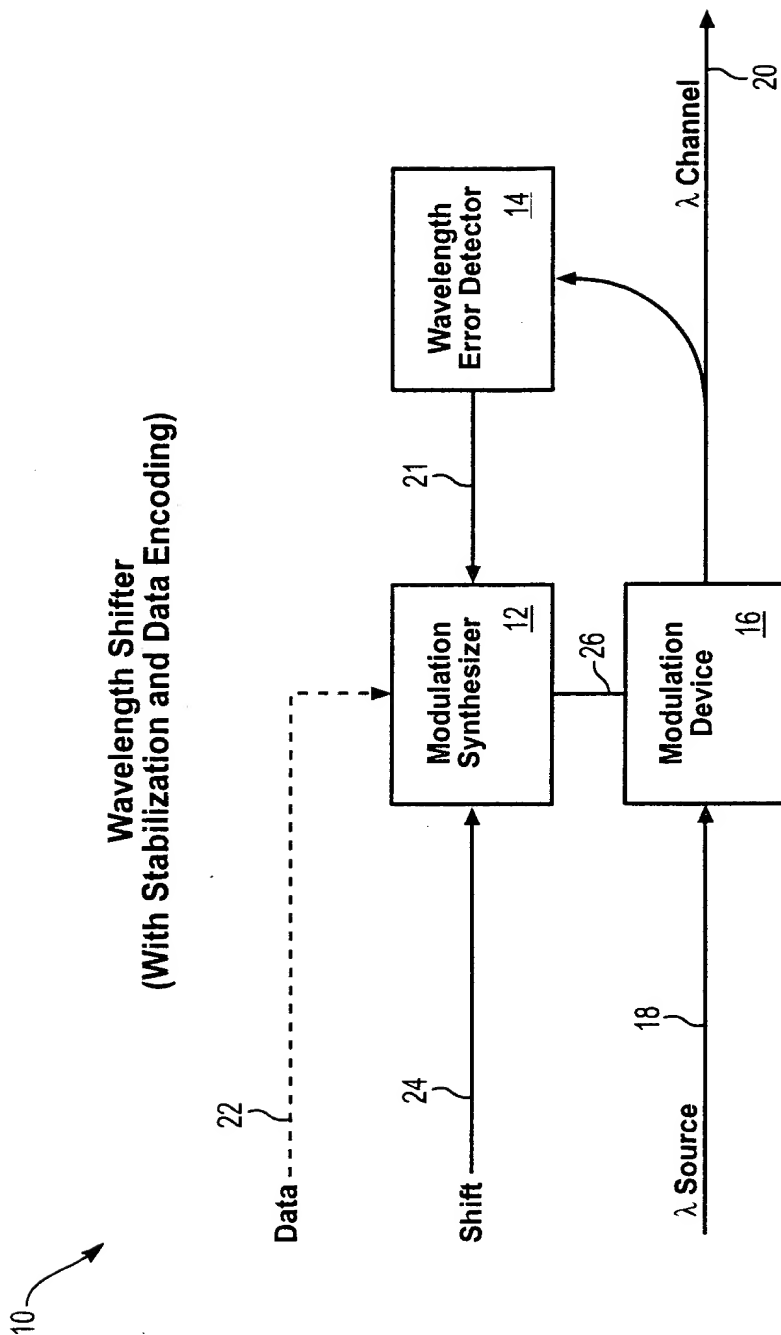


FIG. 1

16a

Quadrature Mach-Zehnder Modulation Device

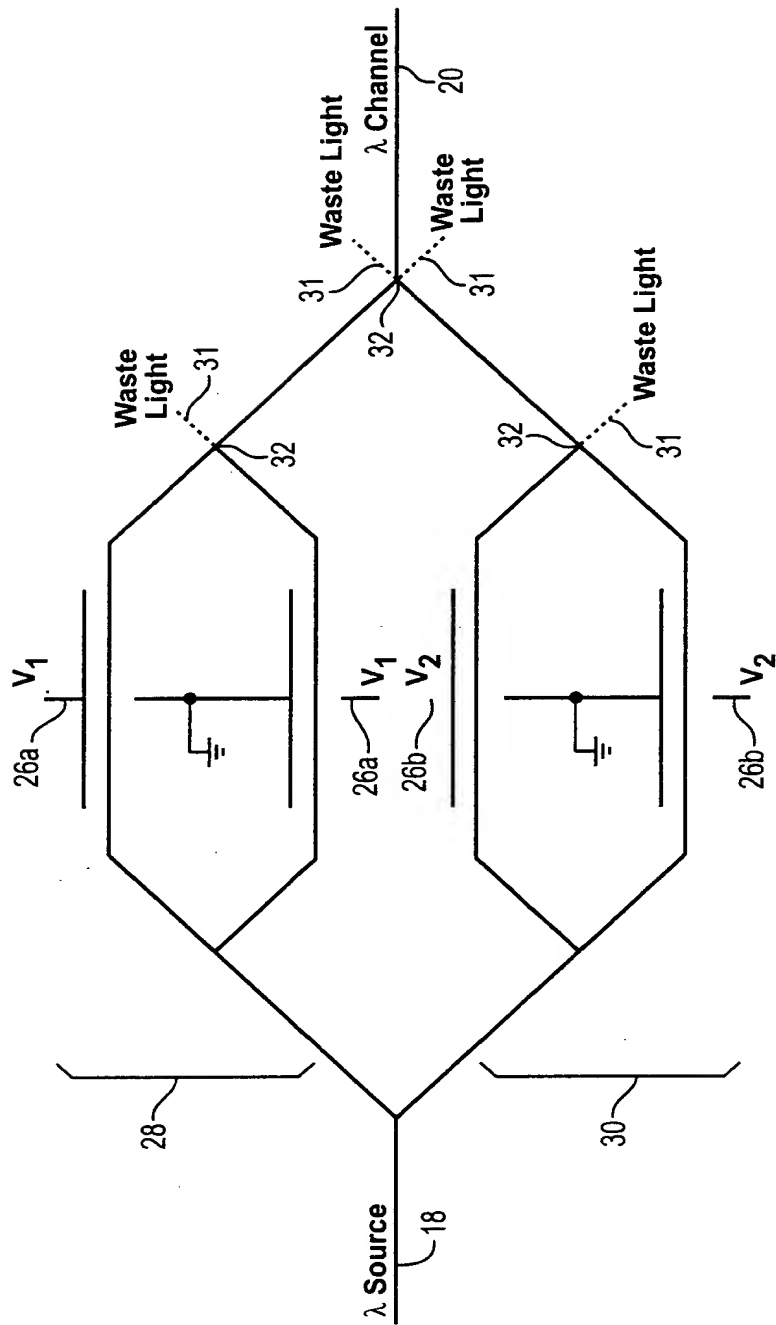


FIG. 2

Mach-Zehnder Device
Transfer Function

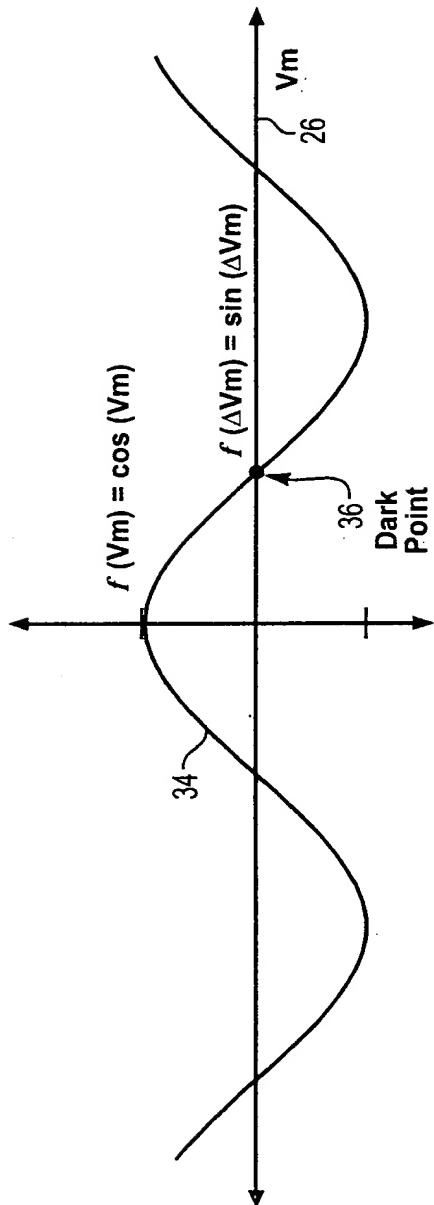


FIG. 3

FIG. 4 is a block diagram of a Modulation Synthesizer 12.

12

Modulation Synthesizer

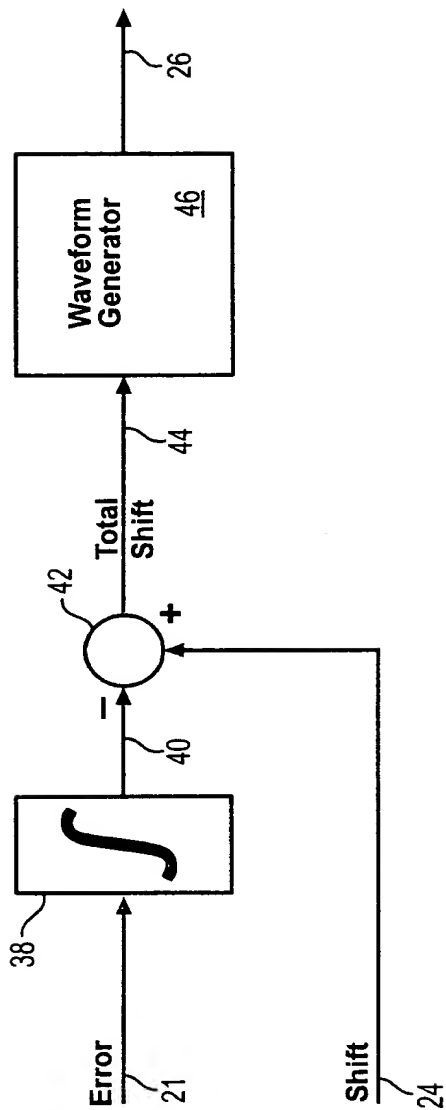


FIG. 4

FIG. 5 is a block diagram of a Quadrature Modulation Synthesizer (With On/Off Data Keying) according to the present invention.

12b

Quadrature Modulation Synthesizer (With On/Off Data Keying)

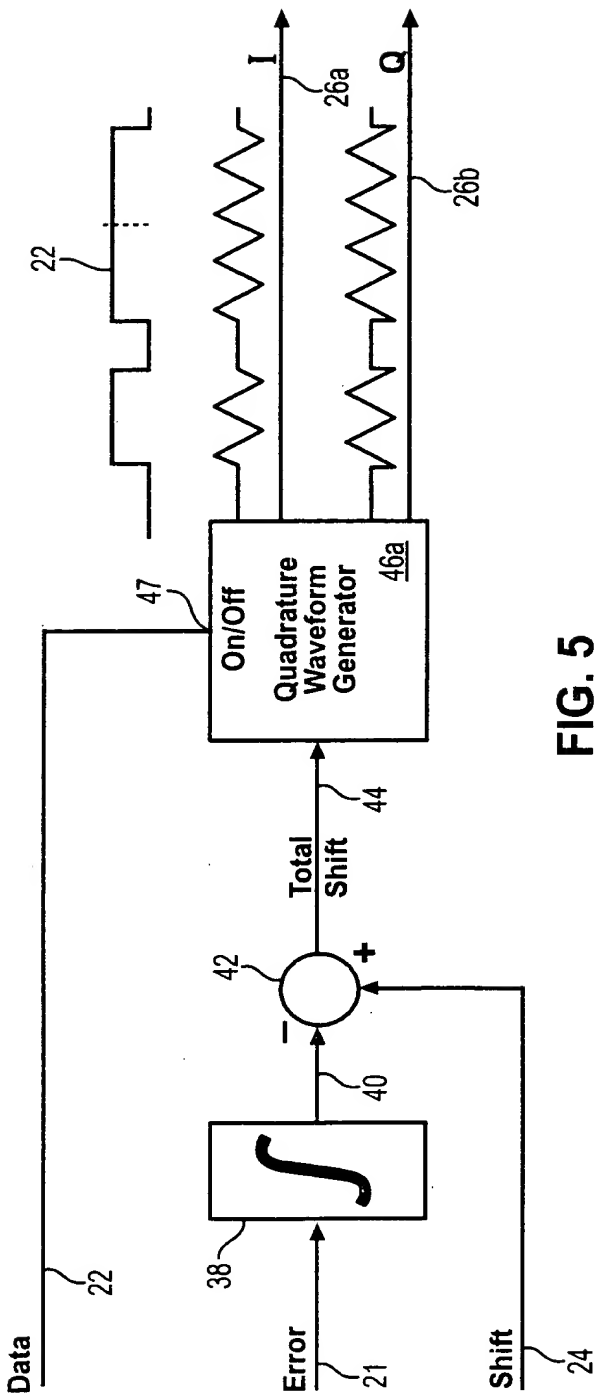


FIG. 5

Phase Modulation Device

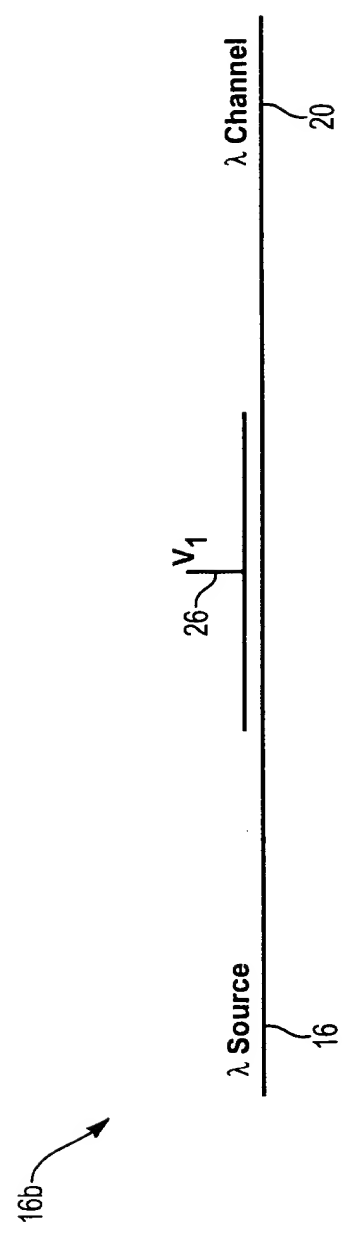


FIG. 6

12c

Modulation Synthesizer (With Frequency Shift Keying)

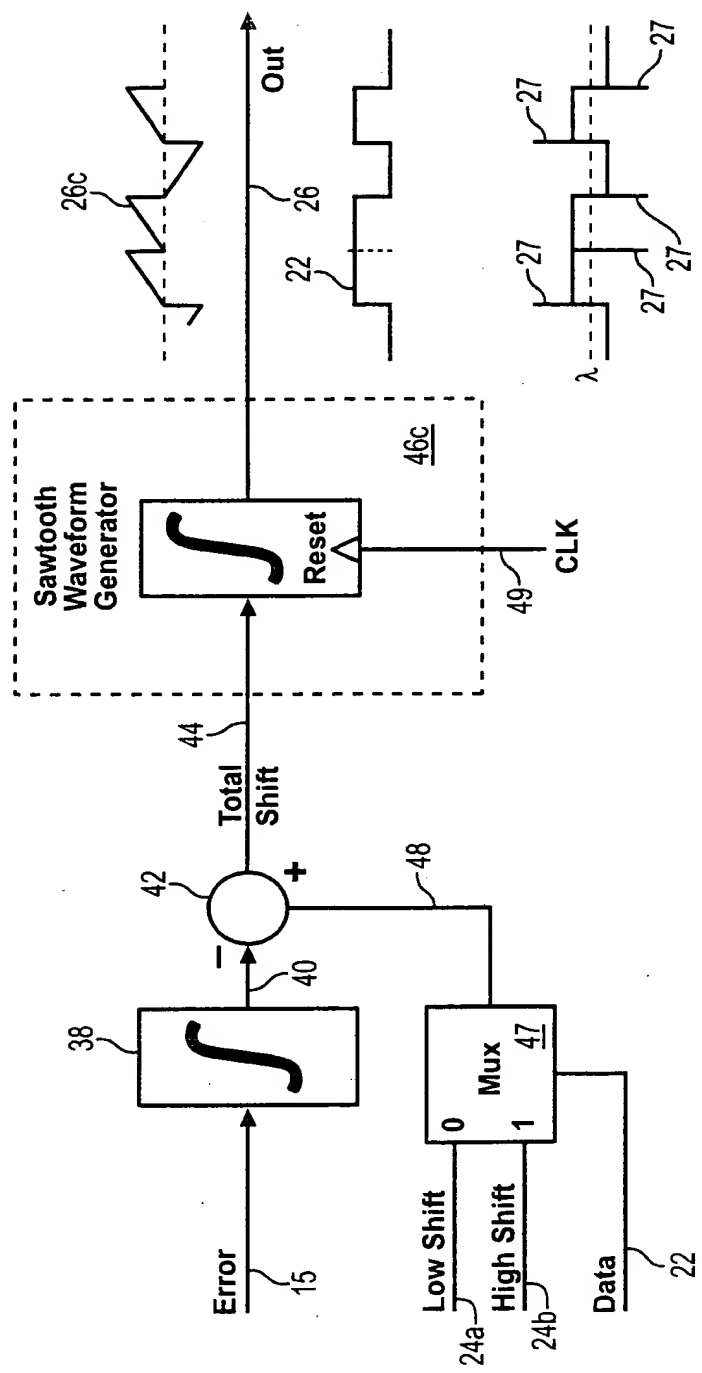


FIG. 7

Wavelength Error Detector (Fixed Wavelength)

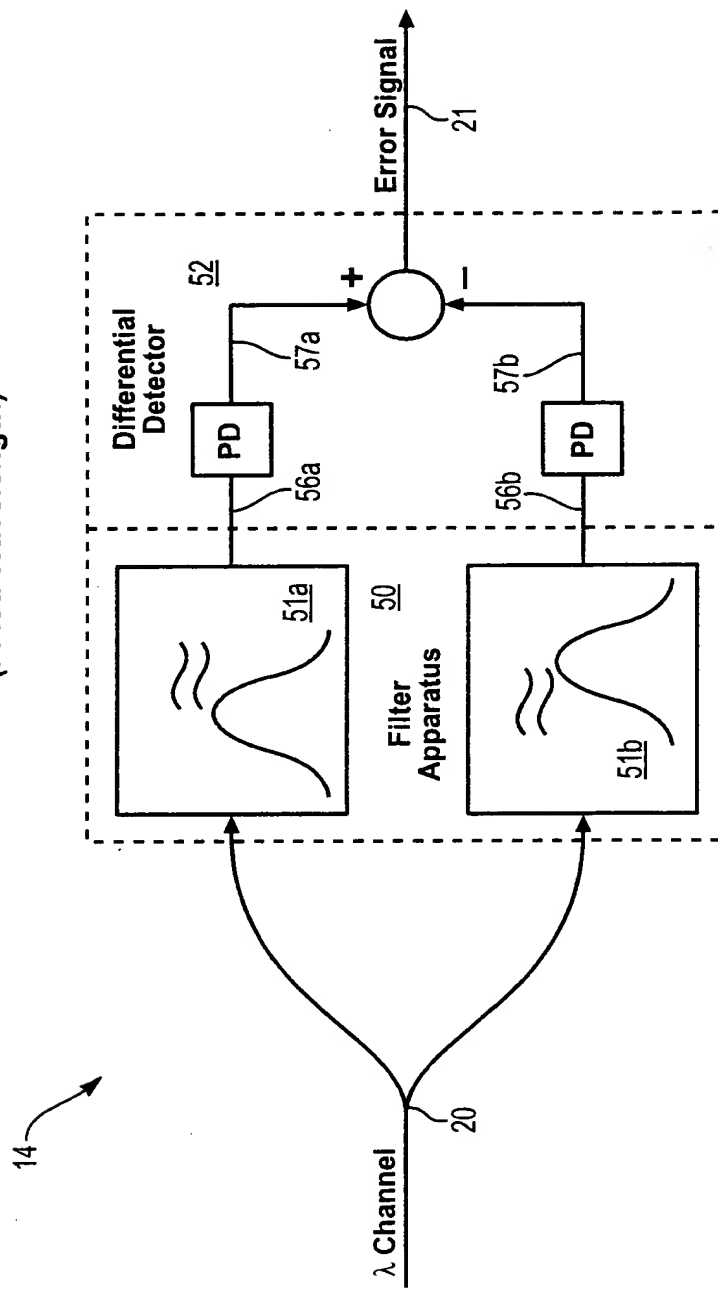


FIG. 8

Wavelength Error Detector (Tunable)

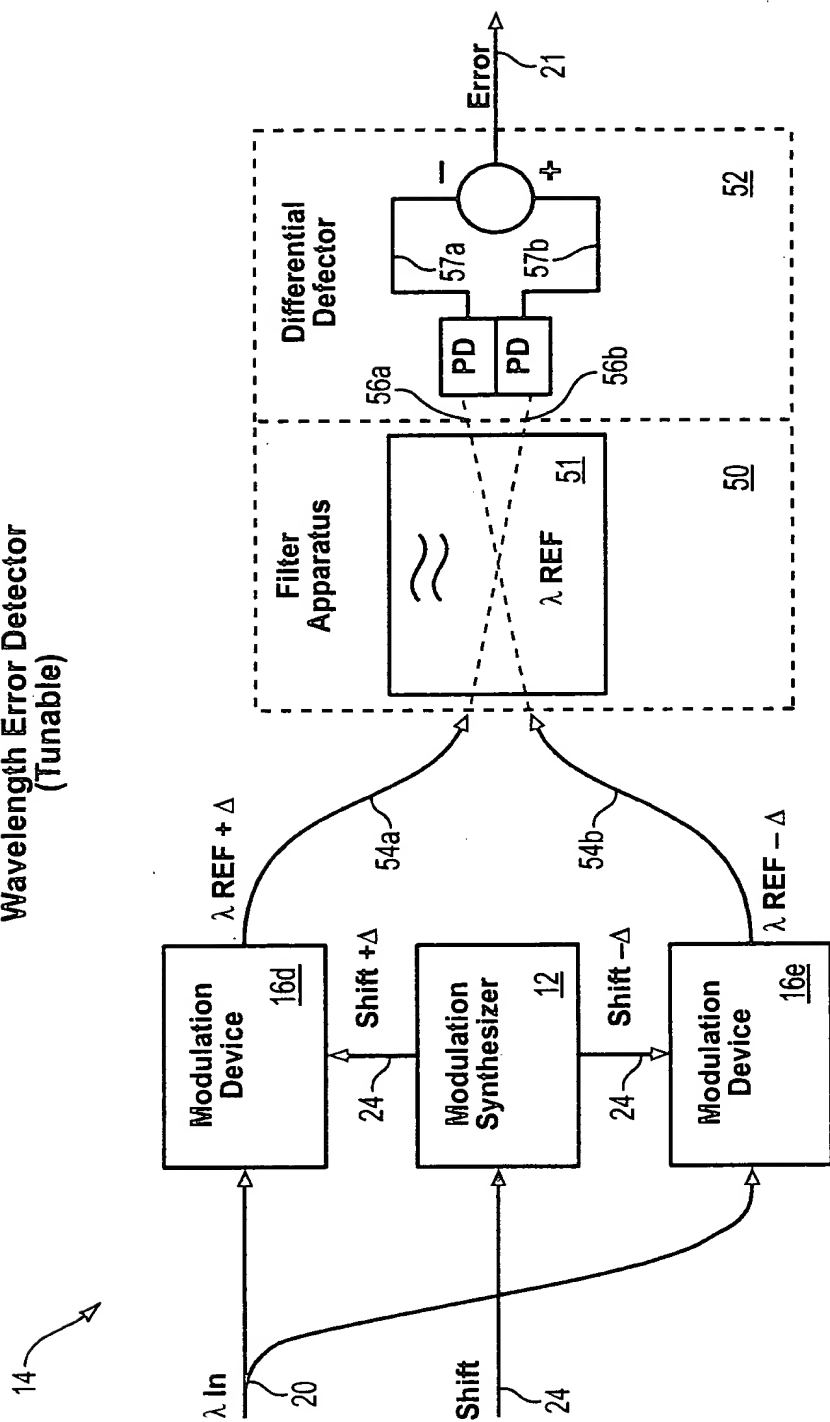


FIG. 9

FIG. 10 is a block diagram of a Wavelength Error Detector (Tunable) 14. The detector includes an input 20, a Modulation Synthesizer 12, and two Modulation Devices 16d and 16e. The input 20 is connected to Modulation Device 16d. The Modulation Synthesizer 12 provides a Shift signal 24 to both Modulation Devices 16d and 16e. The output of Modulation Device 16d is labeled $\lambda \text{ REF} + \Delta$ 54a. The output of Modulation Device 16e is labeled $\lambda \text{ REF} - \Delta$ 54b. These signals are fed into a Filter Apparatus 50, which contains two photodetectors (PD) 55a and 55b. The outputs of the photodetectors are connected to a Differential Defector 52, which produces an Error Signal 21.

Wavelength Error Detector (Tunable)

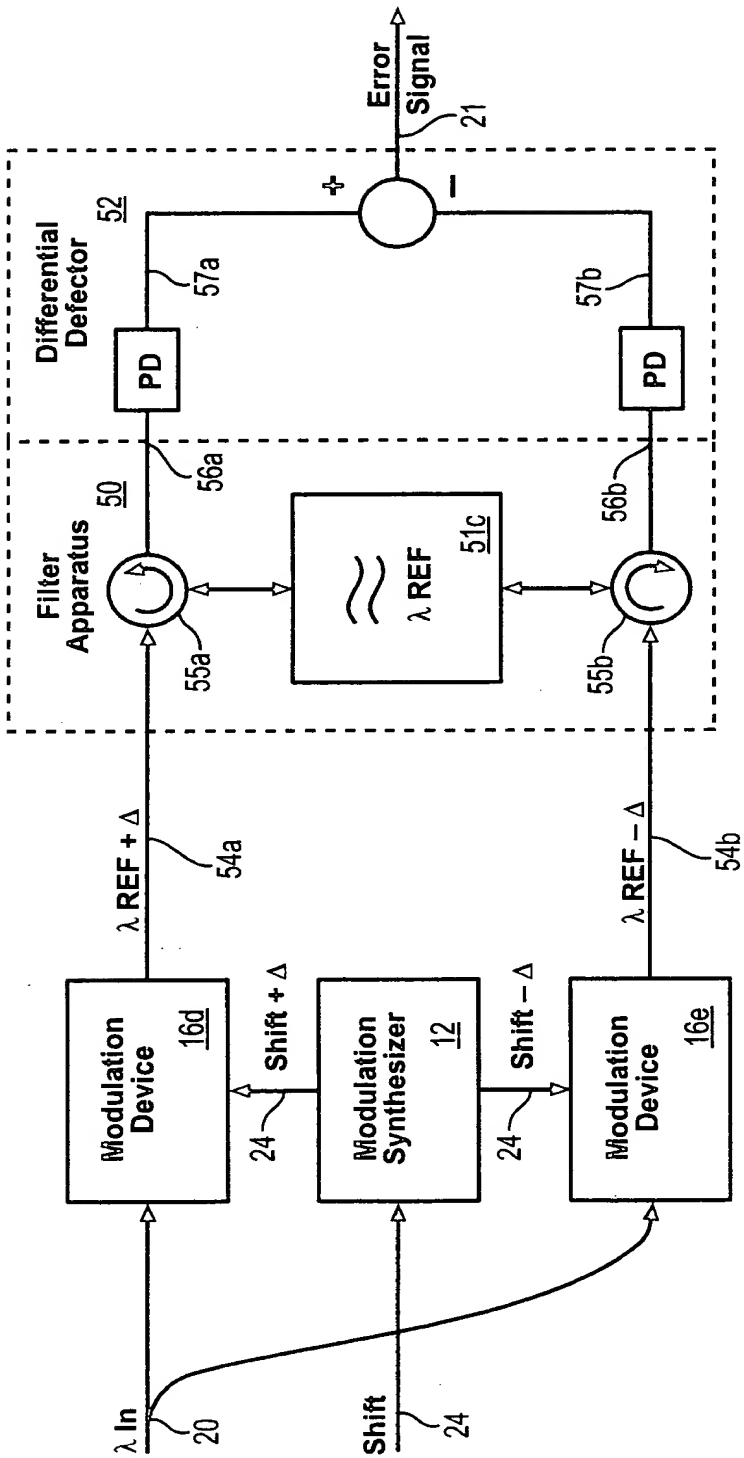


FIG. 10

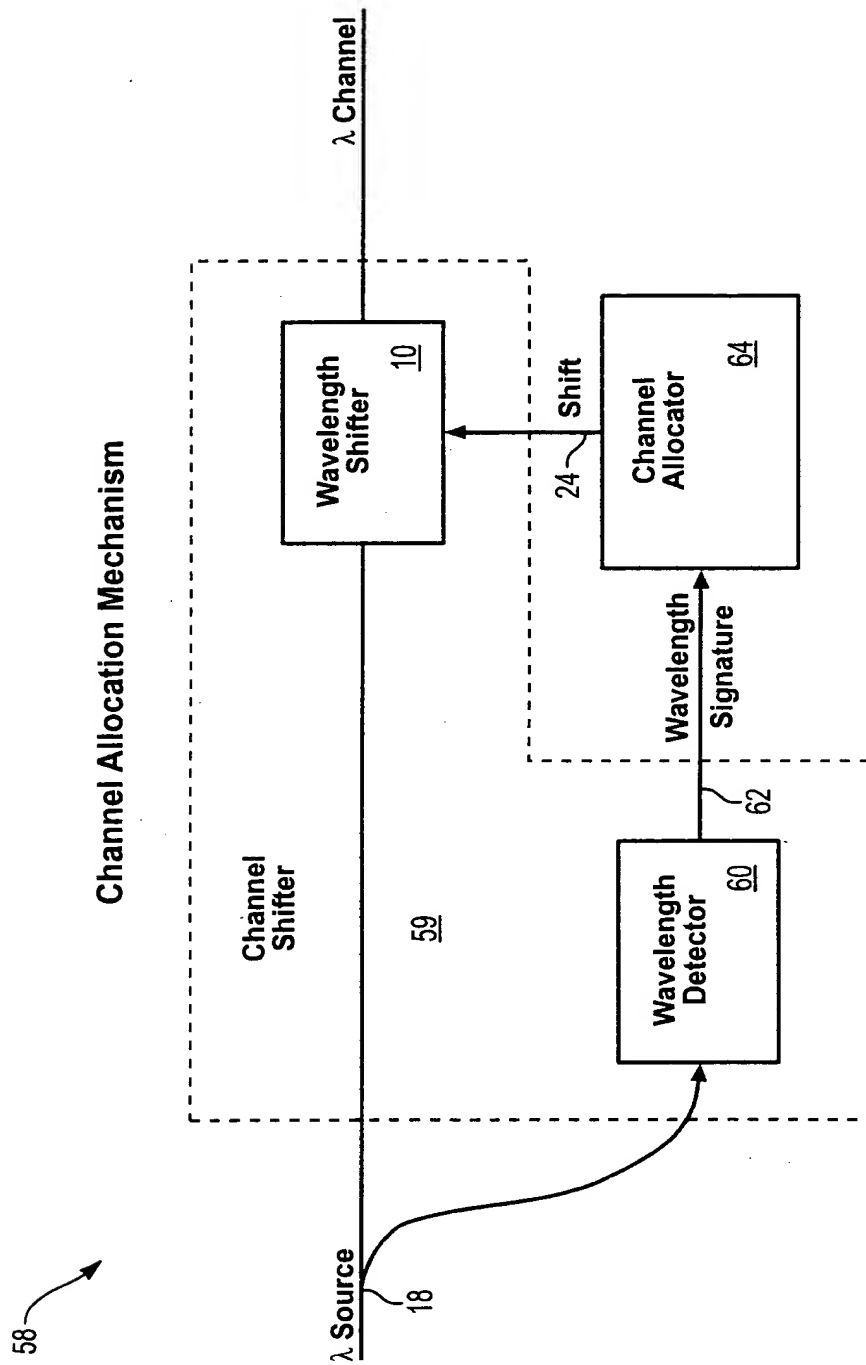


FIG. 11

70

Tunable Wavelength Stabilized Transmitter

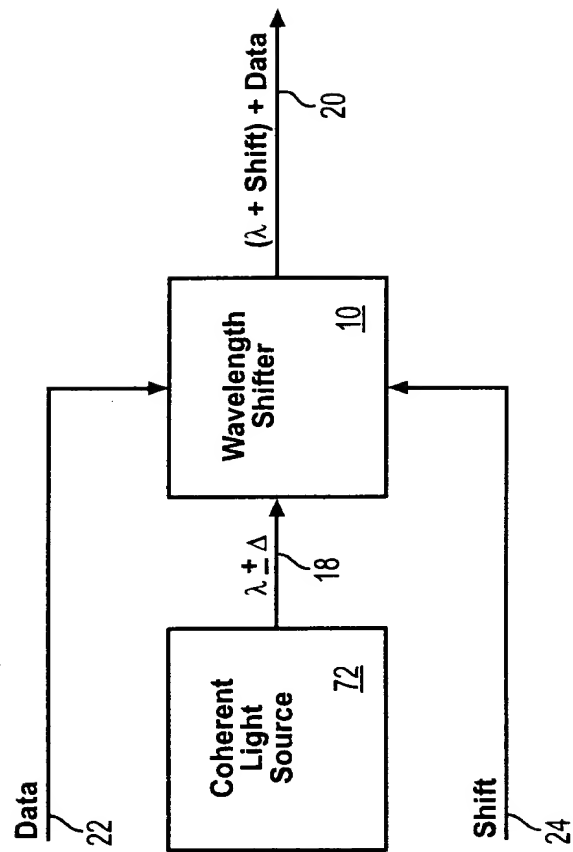


FIG. 12

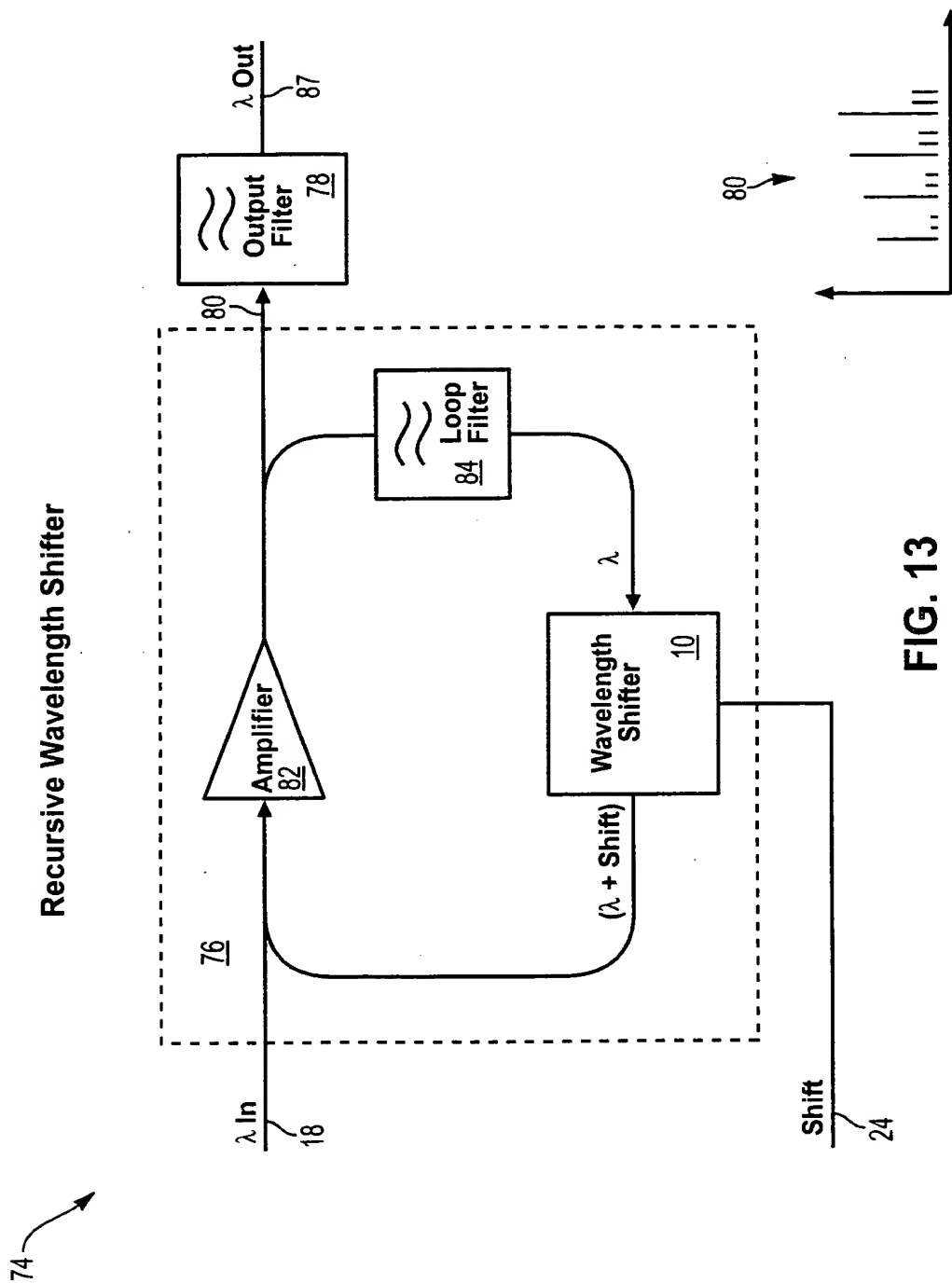


FIG. 13

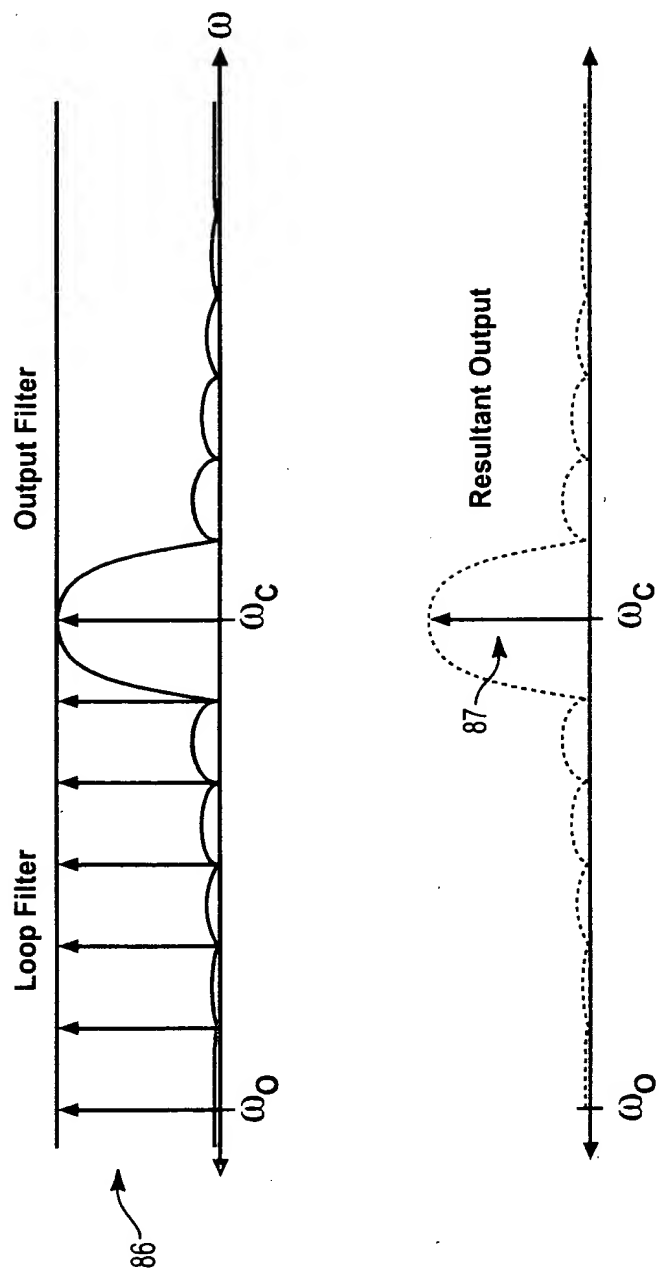


FIG. 14

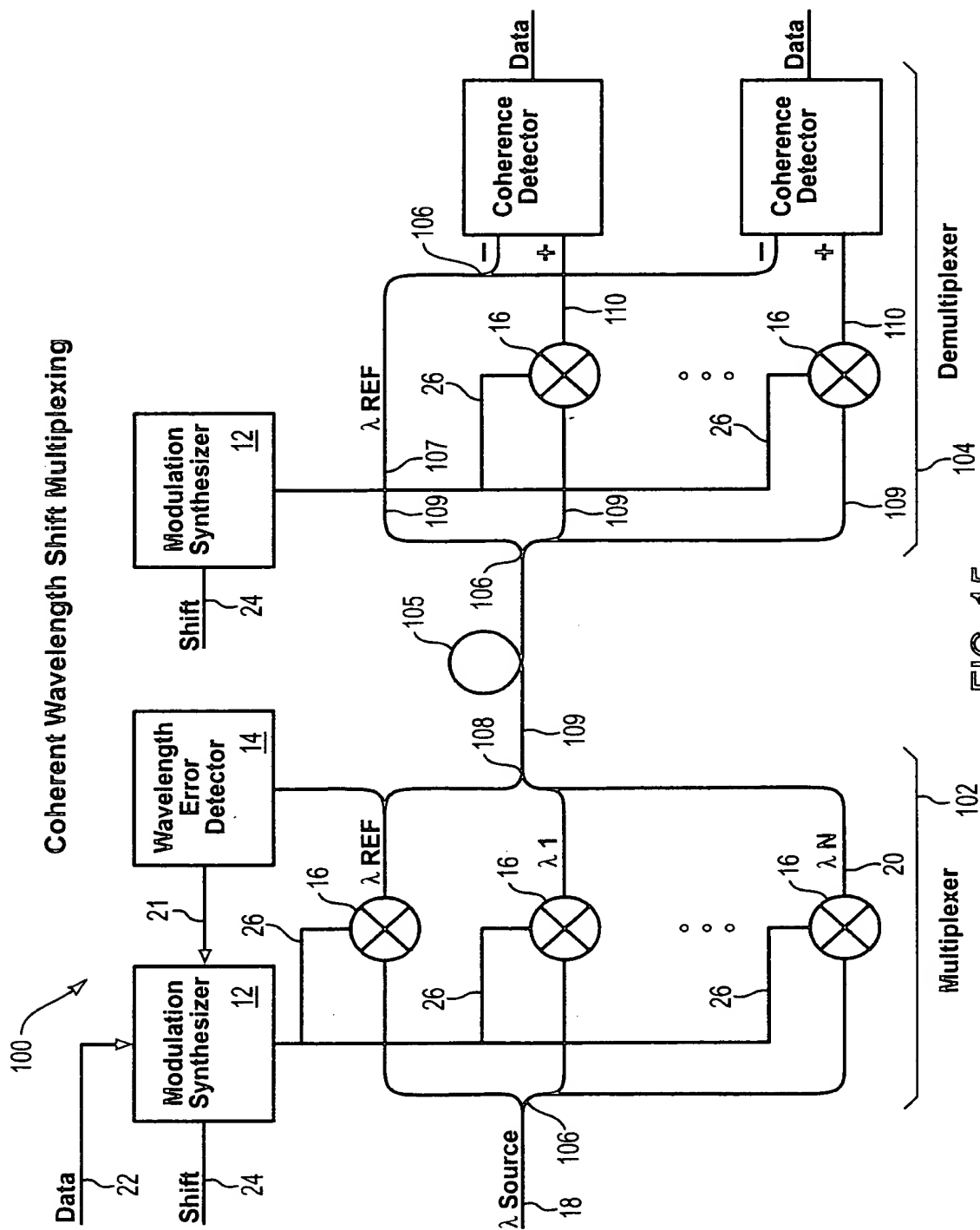


FIG. 15

Full-Duplex Photonic Signals

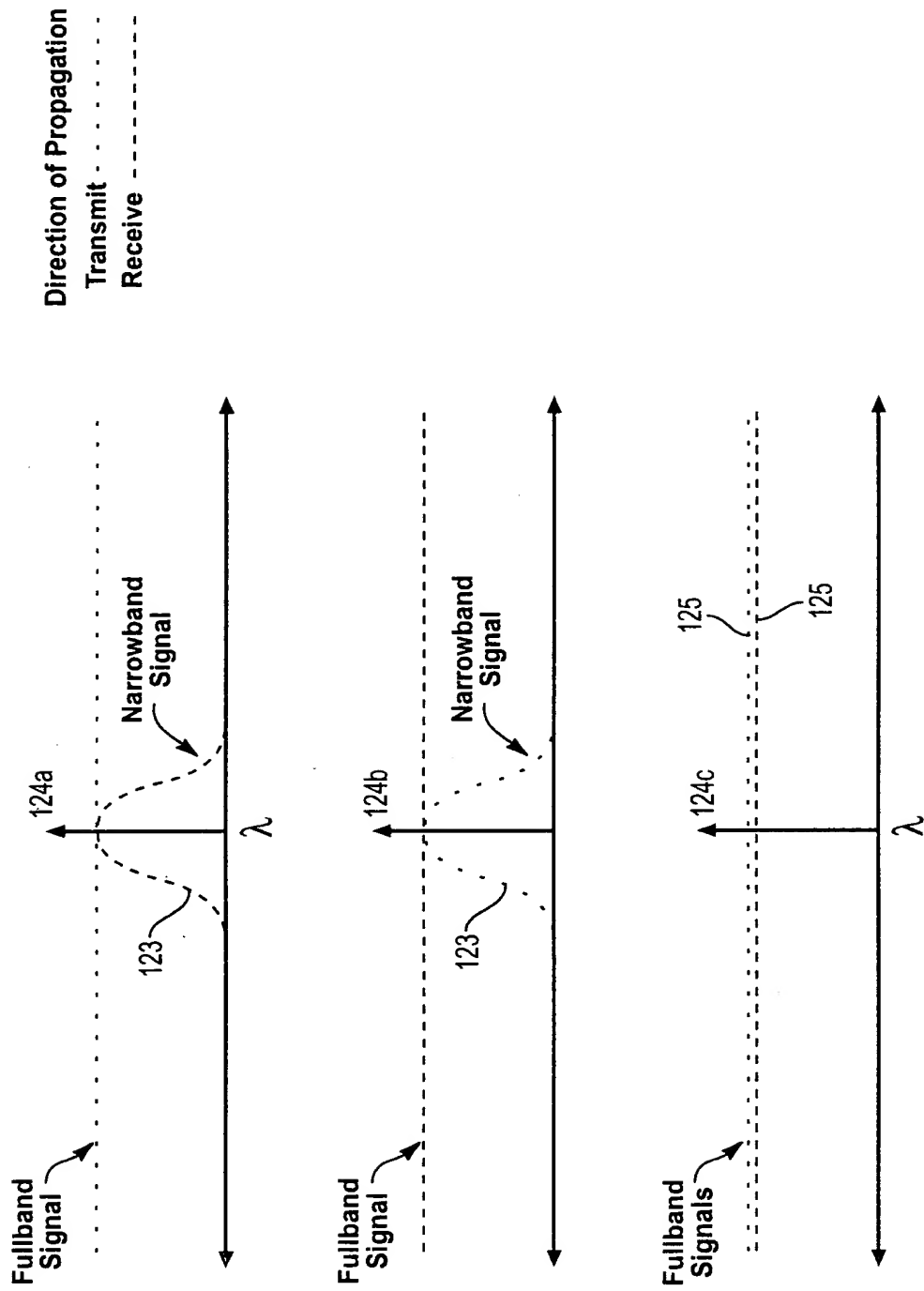


FIG. 16

Wavelength-Shifting Transceivers

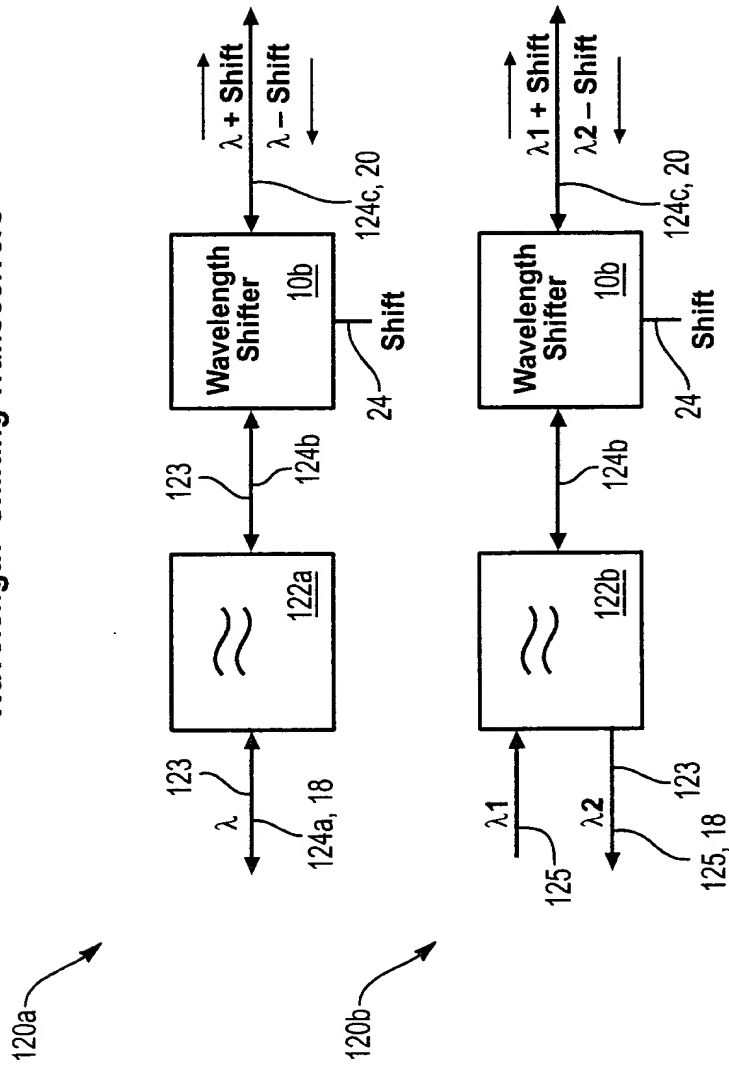


FIG. 17

Full-Duplex Narrowband Filters

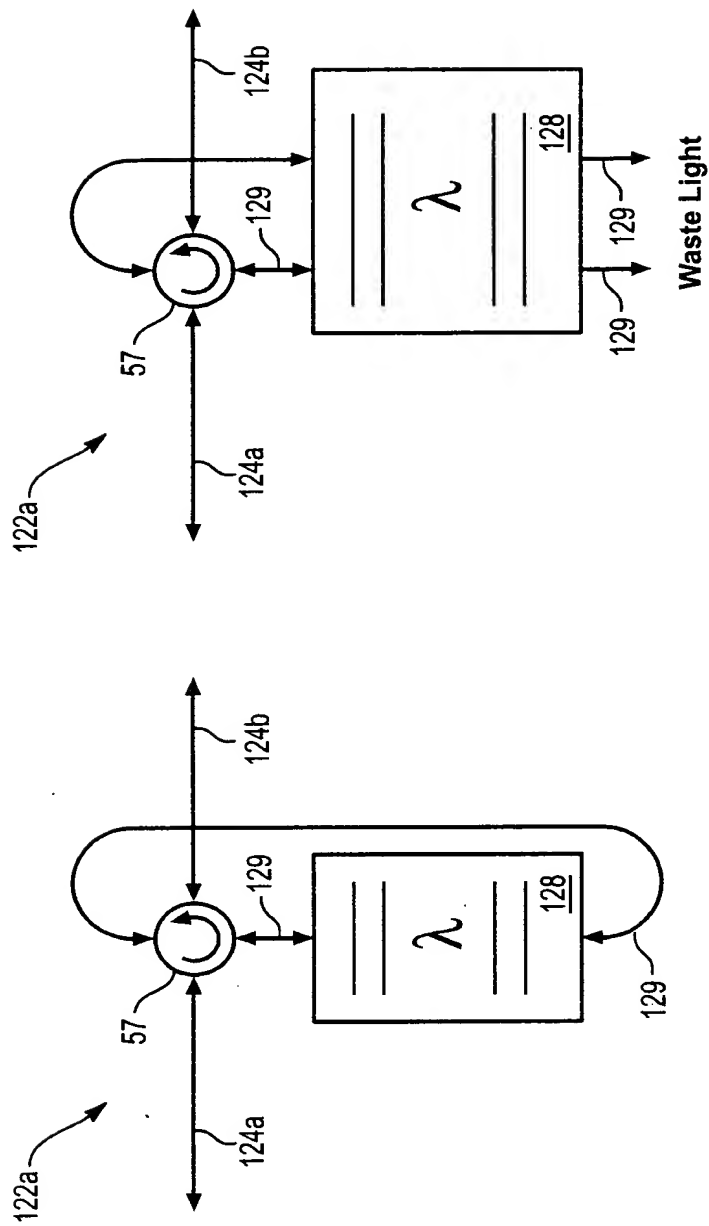


FIG. 18a

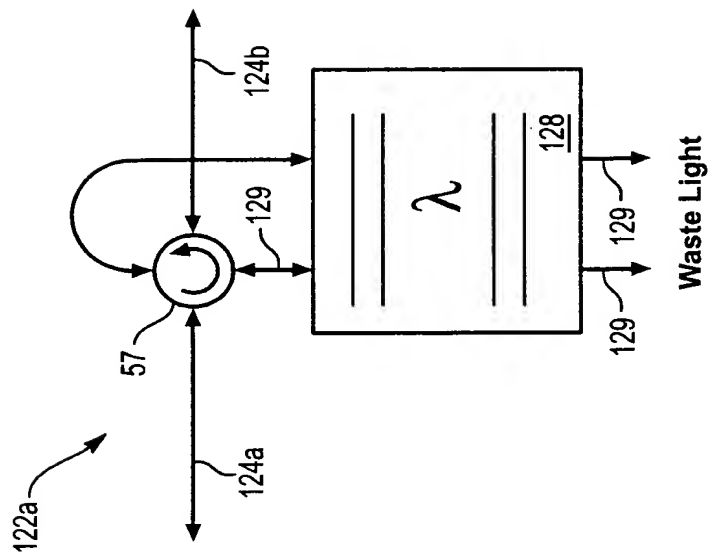


FIG. 18b

Pseudo Full-Duplex Narrowband Filter

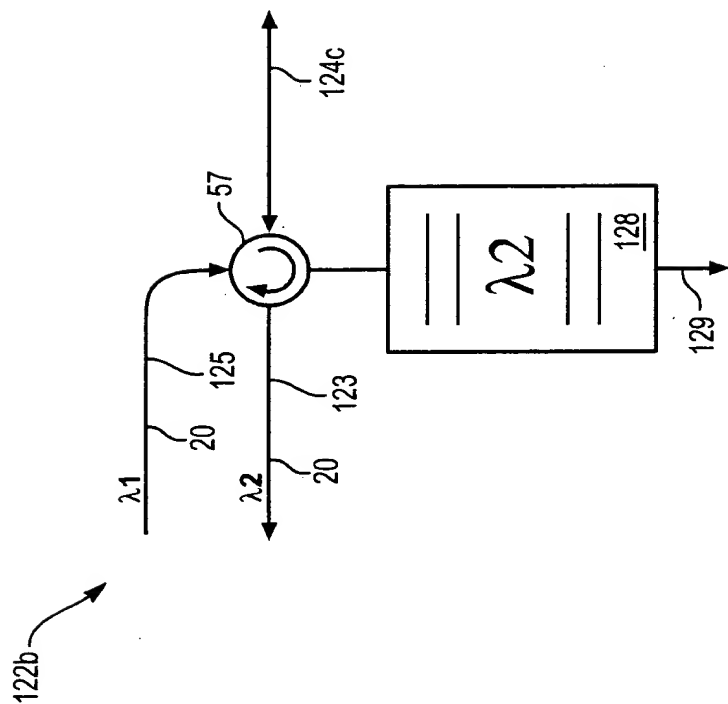


FIG. 19

130

Full-Duplex Crossbar Switch

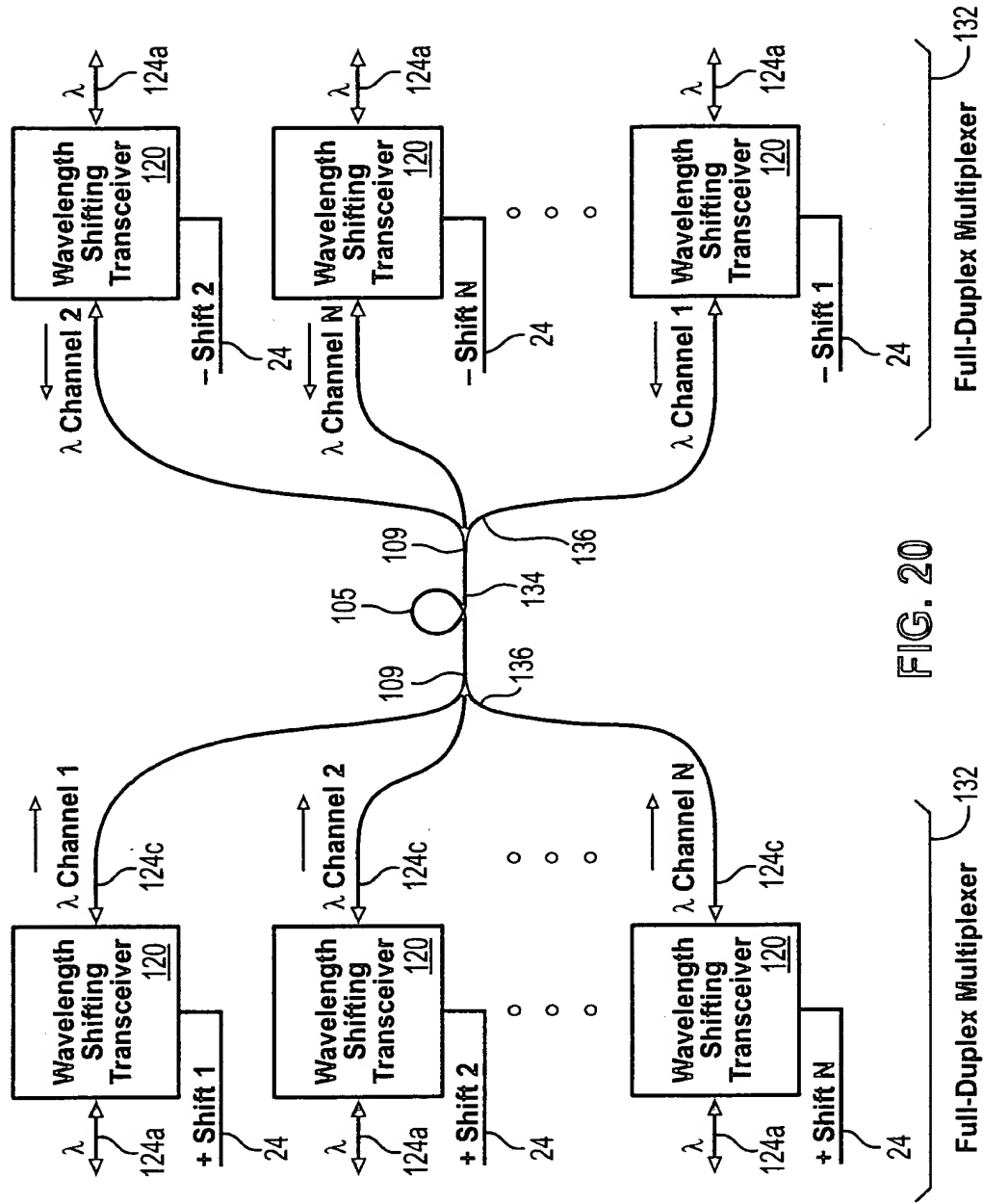


FIG. 20

FIG. 21 is a block diagram of a Full-Duplex Wavelength-Shifting Switch Element 140. The element includes two Wavelength Shifters, 10b and 10b, each receiving a Shift signal (Shift 1 and Shift 2) and a Wavelength Shift signal (124a and 124b). The output of the first Wavelength Shifter (10b) is 124c, which is connected to the input of the second Wavelength Shifter (10b). The output of the second Wavelength Shifter (10b) is 124c, which is connected to the input of the second Wavelength Shifter (10b). The output of the second Wavelength Shifter (10b) is 124c, which is connected to the input of the second Wavelength Shifter (10b).

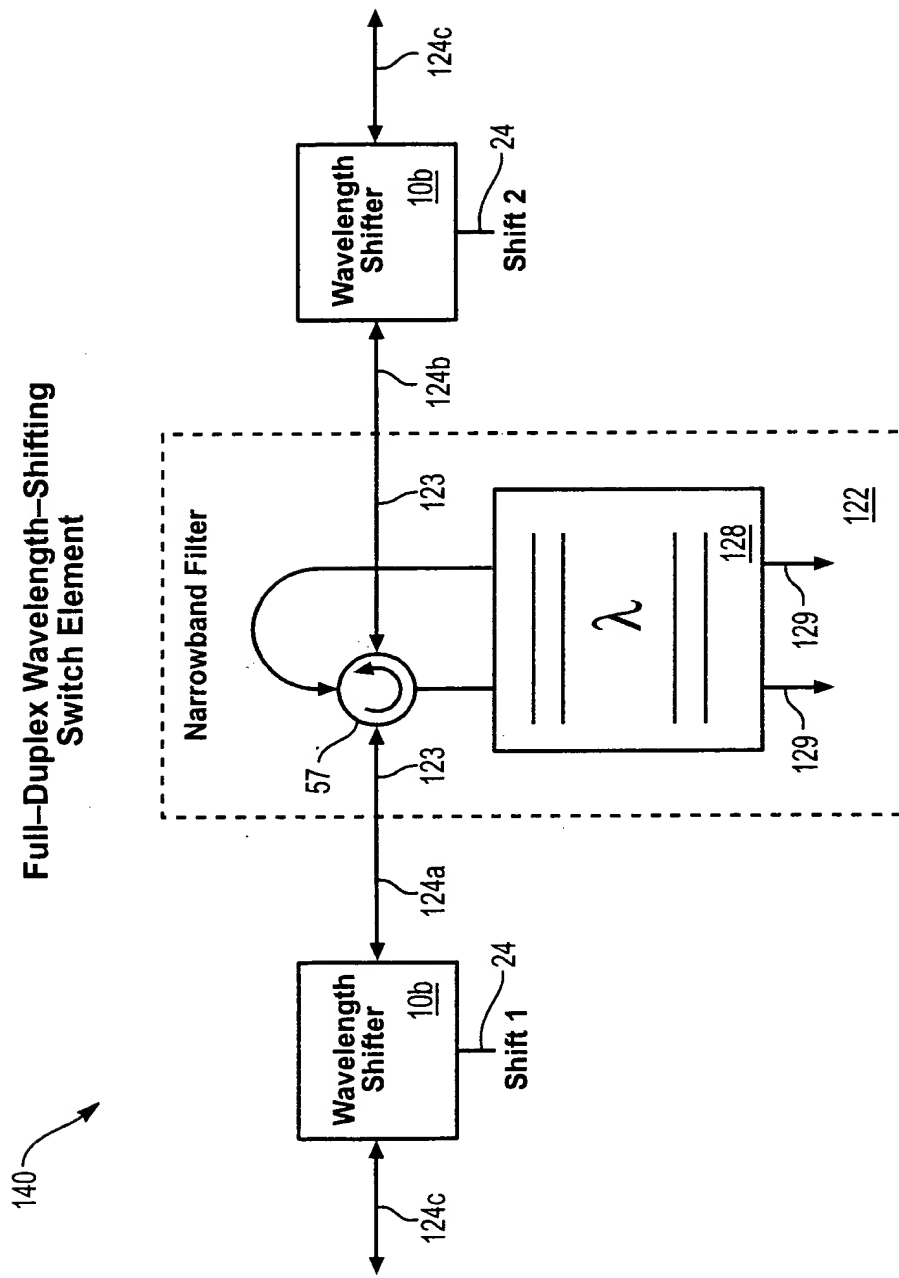
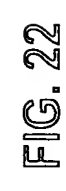


FIG. 21

**Narrowband
Filter**



771

FIG. 23 is a block diagram of a replicated-spectrum transceiver 160. The transceiver 160 includes an input port 166, a spectrum replicator 162, a narrowband filter 122, and an output port 168. The input port 166 receives an input signal λ In 18. The spectrum replicator 162 replicates the input signal to produce a replicated signal λ Replicated 164. The narrowband filter 122 filters the replicated signal to produce an output signal λ Out 20. The output port 168 outputs the output signal λ Out 20.

160

Replicated-Spectrum Transceiver

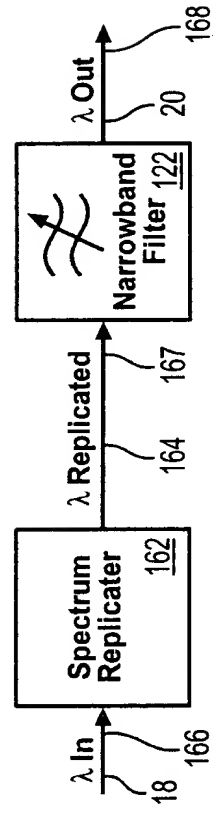


FIG. 23

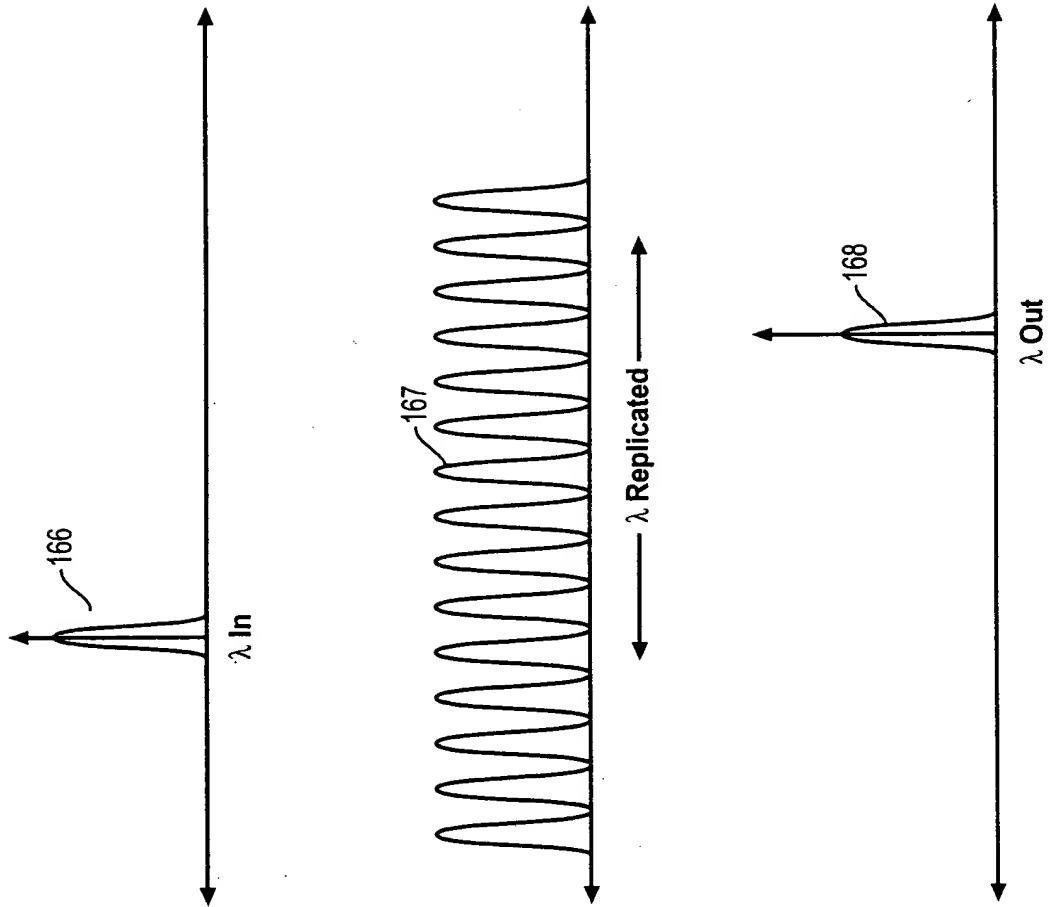


FIG. 24

170

Wavelength-Shifting Replicator

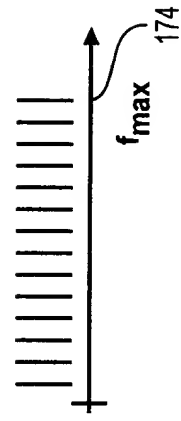
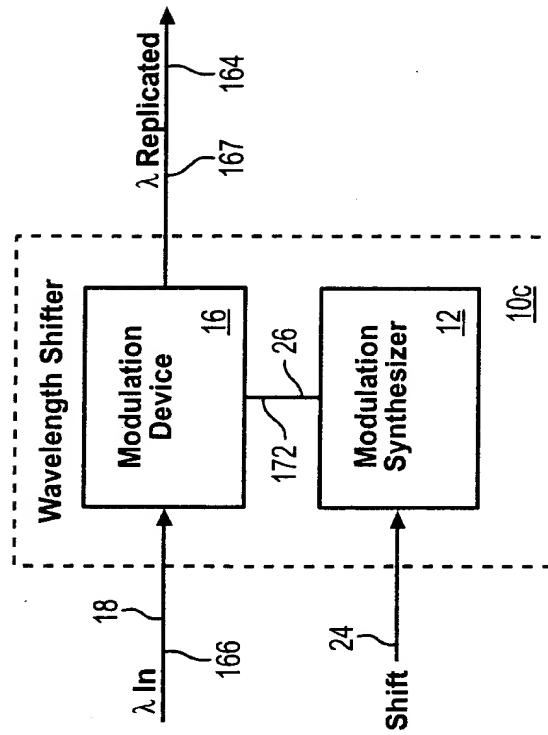


FIG. 25

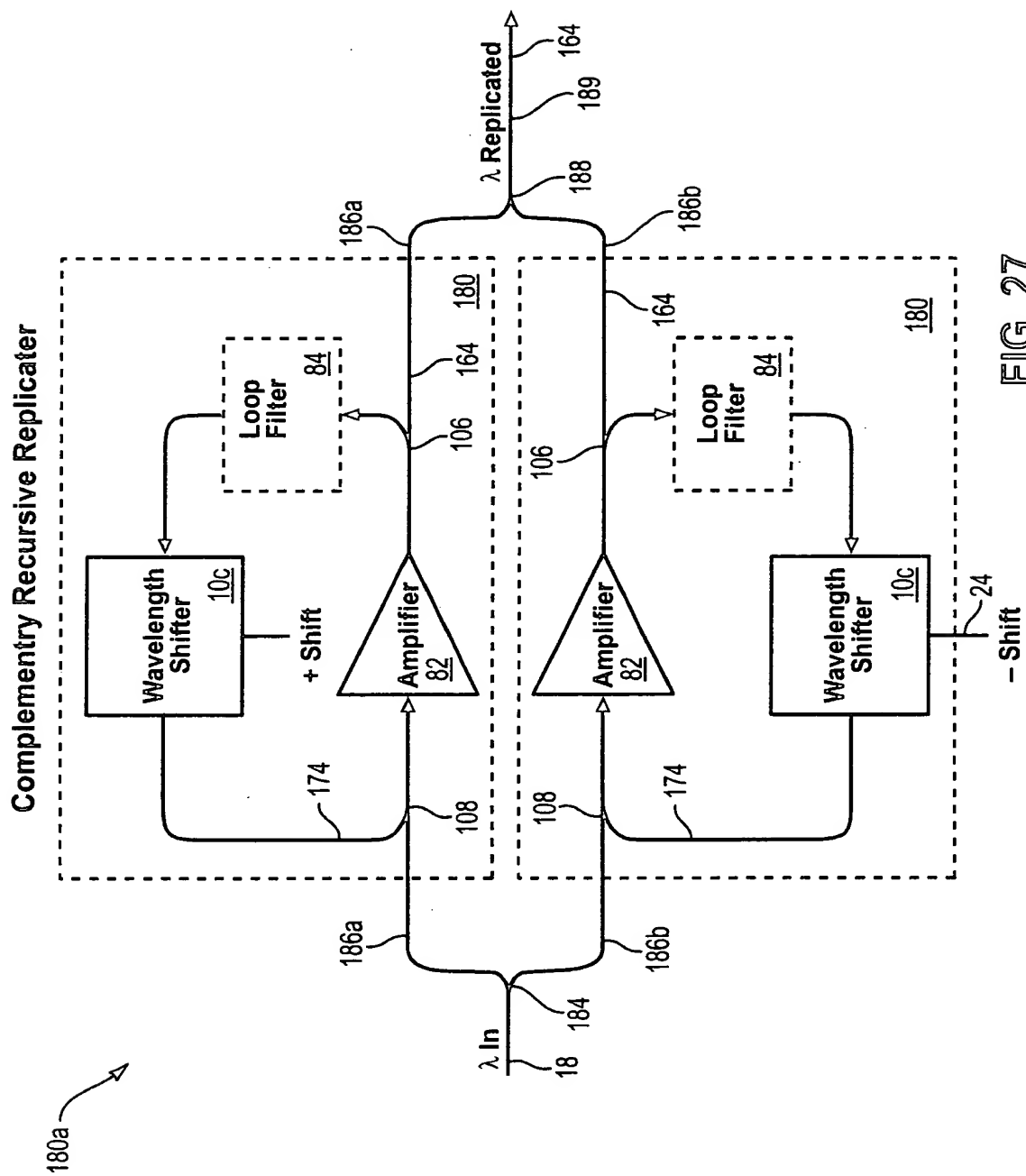


FIG. 28 is a schematic diagram of a four-wave-mixing replicator. The diagram shows an input signal λ In (18) entering a coupler (108). The coupler splits the input into two paths: one path goes through a mixer (192) to produce a mixed signal λ Mix (194), and the other path goes through an amplifier (82) to produce a replicated signal λ Replicated (164). The mixed signal λ Mix (194) is then fed into a second coupler (196), which splits it into two paths: one path goes through a filter (195) to produce a signal ω In ω Mix (197), and the other path goes through a filter (194) to produce a signal ω In ω Mix ω Mix + Δ (198). The replicated signal λ Replicated (164) is also fed into the second coupler (196).

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Four-Wave-Mixing Replicator

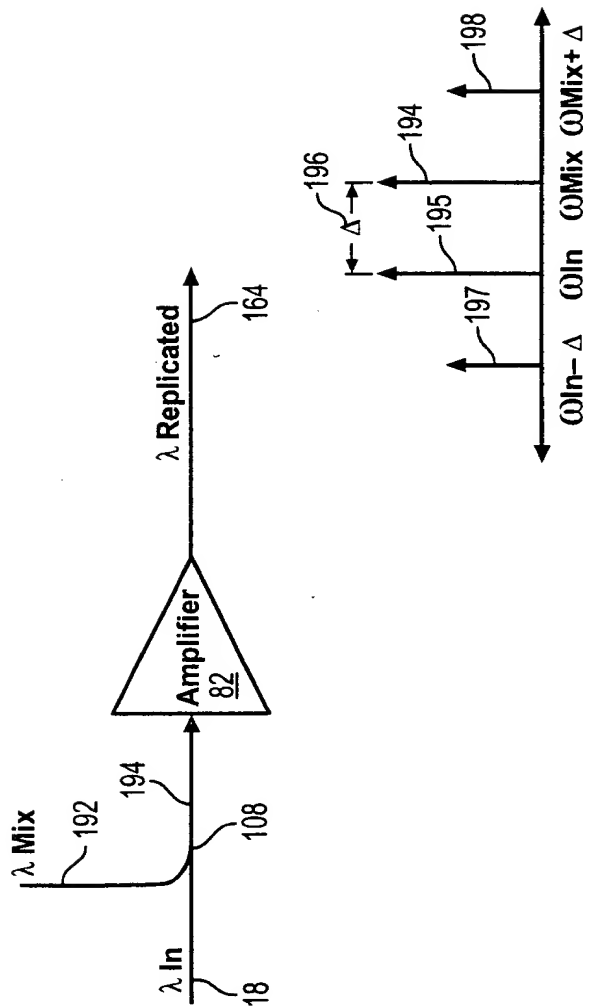


FIG. 28

199

Replicated-Spectrum Multiplexer

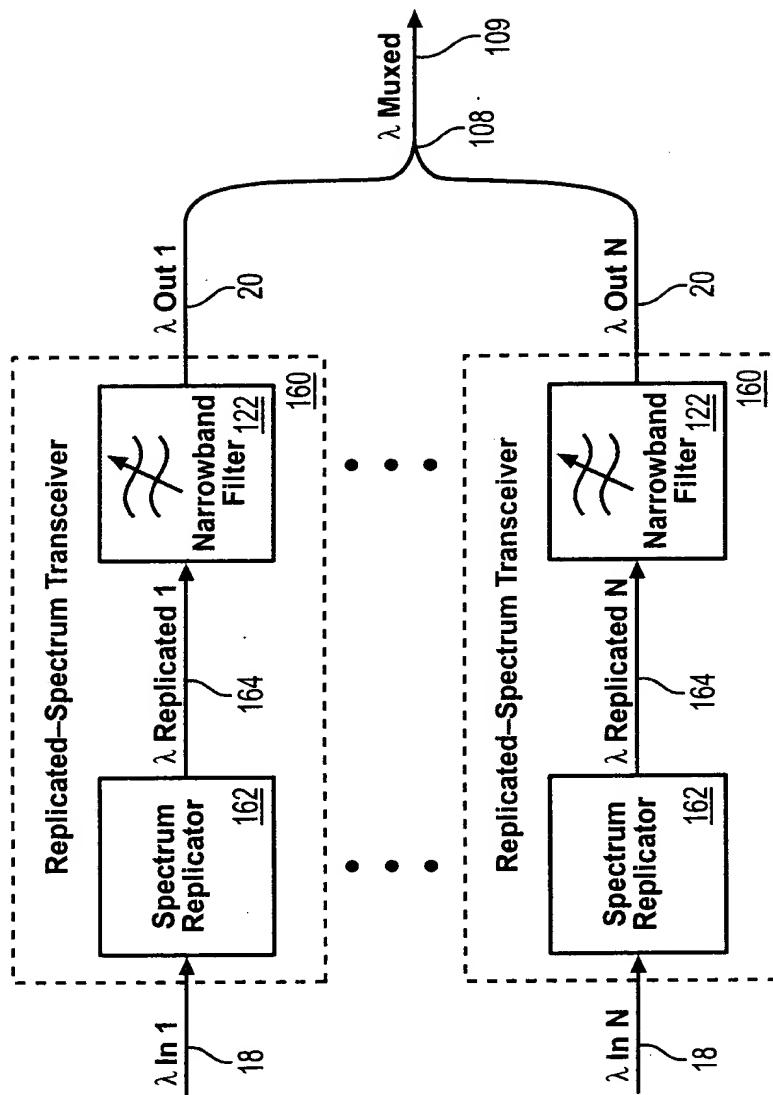


FIG. 29

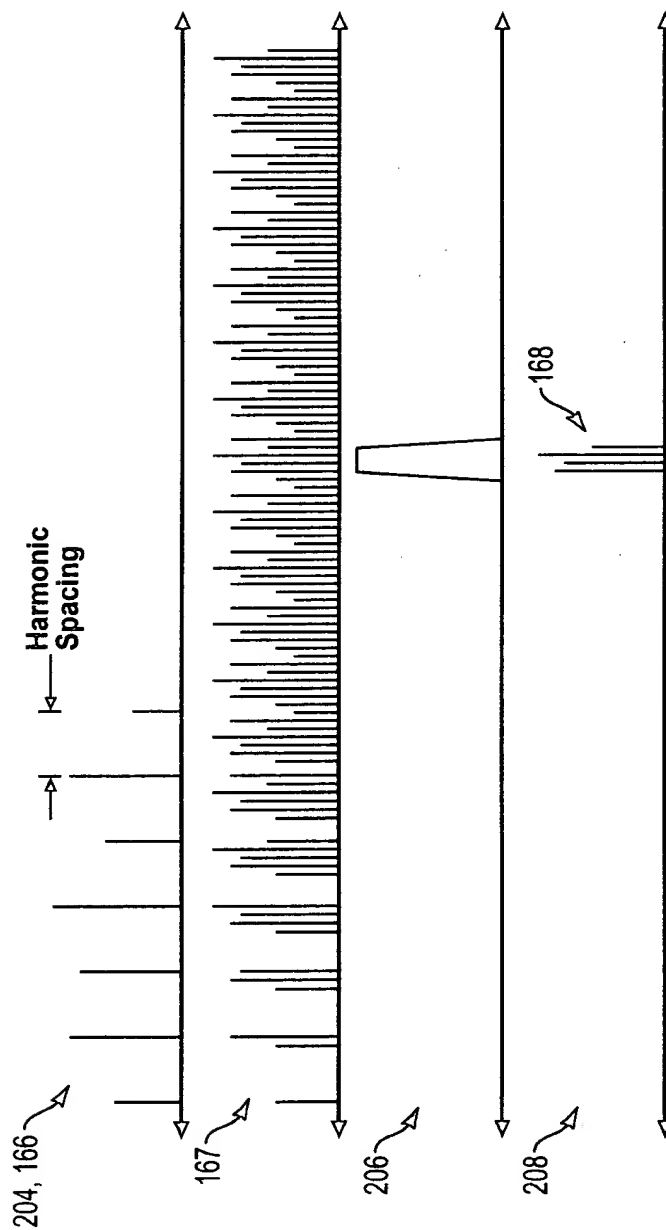
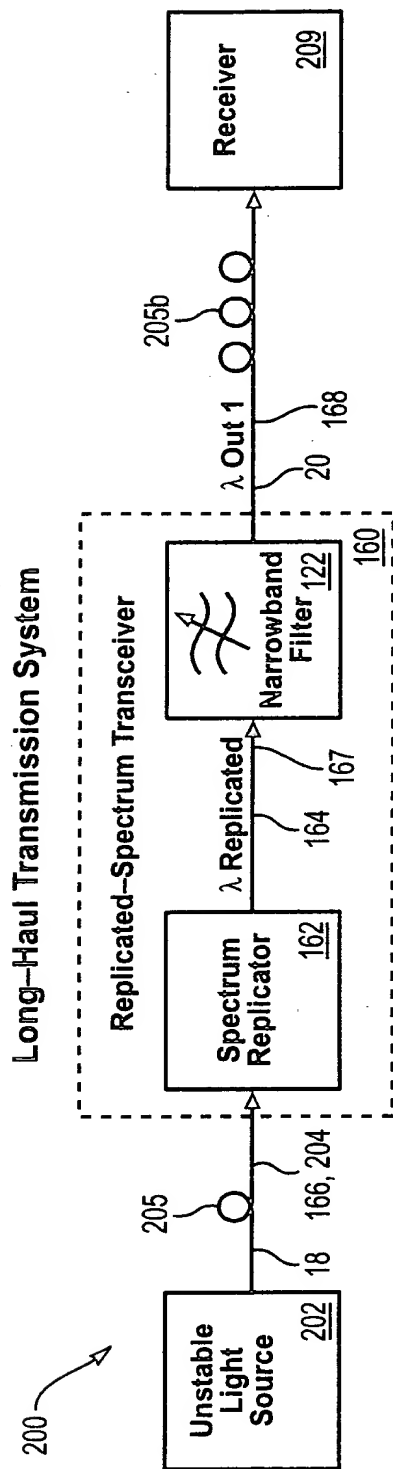


FIG. 30

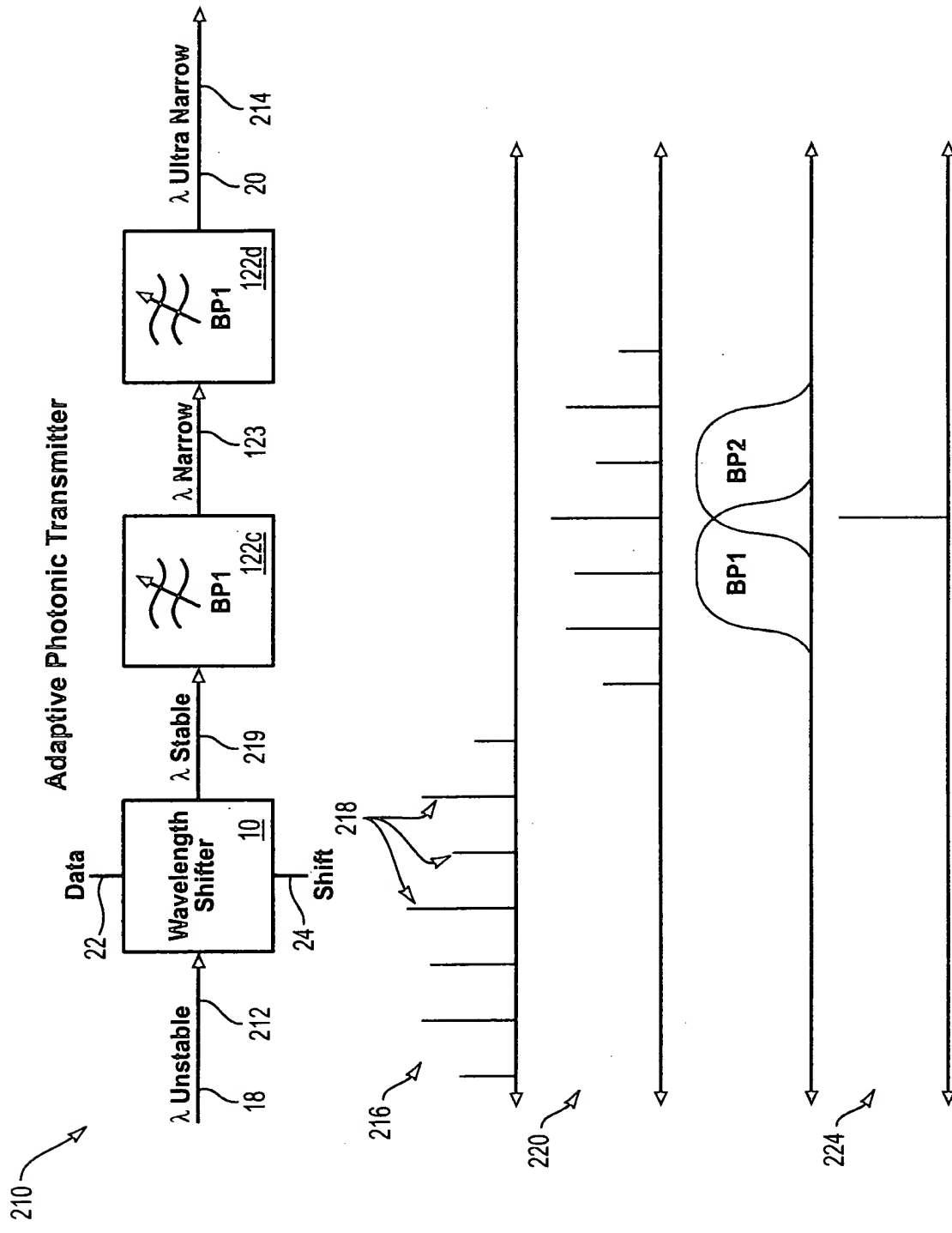


FIG. 31

